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ABSTRACT

This paper examines the impact current maintenance and operations (M&O) practices have on U.S. school performance and offers possible opportunities for improvement through the judicious use of technology and methodology. The paper also presents a regional comparative analysis of M&O costs across the country. A list of equipment and their service life is provided, as are suggested equipment to be considered for M&O programs, the financial benefits of preventive maintenance operations, and ways of integrating new M&O into existing plans. Final sections examine the budgeting of M&O processes in new school construction projects, and the steps school officials can take to implement a proper M&O plan that can avoid excessive costs, protect assets, and increase staff productivity. (Contains 16 references.) (GR)

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MAINTENANCE & OPERATIONS SOLUTIONS: MEETING THE CHALLENGE OF IMPROVING SCHOOL FACILITIES

A report prepared by ASBO International's Facilities Project Team

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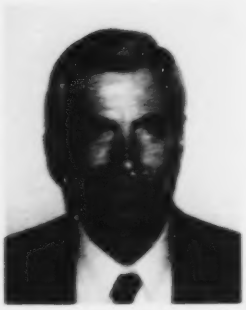

John P. Boaers
Facilities Project Team Chair

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Dear Colleagues:

This is the second publication in a series from the Association of School Business Officials (ASBO) International's Facilities Project Team to assist school business officials with the challenge of improving school facilities.

As school business officials, we strive daily to operate well-maintained schools that are conducive for learning. A quality maintenance program supports these endeavors. The mission of a quality maintenance program is to support student learning by keeping schools in good repair in a cost-effective manner. A quality maintenance program will help school districts avoid costs, protect assets, and increase productivity.

This white paper examines the impact current maintenance and operations techniques and procedures have on the performance of our schools. Possible opportunities to improve that performance in a realistic and thoughtful manner through technology and methodology were examined. By acting upon these untapped "opportunities," public education will be better prepared to address the issues of deferred maintenance and capital cost avoidance with proper planning and use of current internal and external resources.

Our goal was to create useful, realistic solutions to key issues of financing school facilities, technology, and maintenance and operations. It is our sincere hope that the information provided will lead to positive solutions for you and the schools you serve.

Currently, most school districts utilize only the basic operation and maintenance strategies to maintain their facilities. District officials attribute the declining physical condition of America's schools primarily to insufficient funds, resulting in decisions to defer maintenance and repair expenditures from year to year. This lack of resources has caused a crisis in today's schools that threatens the very core of the educational system.

Problems and Resulting Effects of Current Practices

According to the 1996 General Accounting Office (GAO) reports, America's schools needed about $112 billion to repair or upgrade America's investment in facilities to overall good condition. About two-thirds of America's schools reported that all buildings were in at least overall adequate condition, at most needing only some preventive maintenance or corrective repair. However, about 14 million students attended the remaining one-third of schools that reported needing extensive repair or replacement of one or more buildings.

From 1950 to 1970 when the need for new classrooms was high, communities and school districts built schools fast and at low bid. Now those schools are paying the price and account for much of the $112 billion of deferred maintenance. More than 72% of today's schools were built after 1950.

The life-cycle cost of a school building is only partially represented by the initial costs of design and construction. A well-designed and constructed school can save in energy usage, maintenance and operations allowing the school district to generally recoup the added initial cost in less than five years with savings that continue for 40 more years. Table 1 shows the life-cycle costs of a fast, low-bid school versus a well-designed school.

Further research has shown:

- A recent study of school systems in three states found a positive relationship between school condition and both student achievement and student behavior (Department of Education, 1998).
- One study found that students who attended schools in poor condition scored 5.5 percentage points below students who attended schools in fair condition and 11 percentage points below students who attended schools in excellent condition (AASA, 1992).
- A study of working conditions in urban schools concluded that physical conditions have direct positive and negative effects on teacher morale, sense of personal safety, feelings of effectiveness in the classroom, and on the general learning environment (Corcoran, Walker, White, 1998).
- Studies in several states indicate situations where structural damage resulting from age compounded by improper or deferred maintenance has forced the closing of a number of school buildings. There have even been reports detailing the collapse of entire sections of schools (Honeyman, 1990).
- On average, most maintenance employees are only between 25% and 35% productive due to poor maintenance management (Wireman, 1994).

Table 1—Life Cycle Costs

	Fast, Low-Bid School	Well-Designed School
Renovations	14.90%	11.42%
Maintenance	13.29%	12.10%
Operations	16.47%	14.12%
Initial Construction	20.07%	23.12%
Interest	23.95%	26.40%
Furnishings-Replacement	3.90%	4.43%
Furnishings-original	5.96%	6.64%
Initial Architectural Fees	.99%	1.33%
Land	.40%	.44%

Facilities are becoming the hub of the community causing higher than expected building and system use, yet maintenance budgets are often level or reduced. Additionally, technology, specialized classrooms and ADA requirements are increasing the workload of the maintenance department. The old maintenance concept – fix it when it when it breaks – cannot meet the current expectations for school facilities. This approach not only costs the school more in the long run due to high repair and replacement costs, but it also has maintenance staff perform in a reactive mode. Additionally, the training needed to maintain these state of the art facilities often becomes part of the budget cuts.

Current Approaches & Focus

School districts are experiencing a widening gap between available internal resources and their ability to meet the increasing needs of the district's students, staff, and community. Traditionally, the school district's maintenance staff has had a growing list of responsibilities and a decreasing budget with which to complete their tasks.

According to American School & University's 29th Annual Maintenance & Operations Cost Study (http://www.asumag.com/research/Maint-School2000.html), during the 1999-2000 school year, school districts nationwide allocated about 9% of their net current expenditures (NCE) to maintenance and operations. This allocation represented the third consecutive year that schools used a smaller percentage of their budgets to preserve and run their facilities, in comparison to 11% of NCE a little more than a decade ago.

Additionally, the amount of square feet maintained per custodian has increased to 21,156 square feet from 20,612 square feet two years ago. Acreage maintained per grounds worker also increased to 41 acres from 33 acres two years ago.

The decrease in percentage of budget for operating facilities may be due to maintenance staffs becoming more efficient with dollars, smarter buildings, and technology. The goal should be to minimize costs and still get high quality results. Table 2 shows regional costs for maintenance and operations during the 1999-2000 school year.

Table 2—Regional Maintenance and Operations Costs in Dollars per Student and Square Foot During the 1999-2000 School Year

REGION	Cost/ STUDENT	Cost/ SQ FT
Region 1 (CT, MA, ME, NJ, RI, VT)	$622.48	$3.87
Region 2 (NJ, NY)	$692.57	$5.28
Region 3 (DC, DE, MD, PA, VA, WV)	$617.89	$4.19
Region 4 (AL, FL, GA, KY, MS, NC, SC, TN)	$489.84	$3.02
Region 5 (IL, IN, MI, MN, OH, WI)	$627.88	$4.03
Region 6 (AR, LA, NM, OK, TX)	$572.29	$2.96
Region 7 (IA, KS, MO, NE)	$524.60	$3.28
Region 8 (CO, MT, ND, SD, UT, WY)	$480.80	$3.14
Region 9 (AZ, CA, HI, NV)	$537.59	$5.39
Region 10 (AK, ID, OR, WA)	632.55	$4.92

In 1999-2000, schools spent a greater portion of limited funds on instruction and less on maintaining and operating buildings or buying and repairing equipment in cities where greater numbers of students live in poverty. In urban school districts about 3.5% of the budget was typically spent on facilities maintenance. Of this amount, 85% was budgeted for emergency repairs and only a small amount remained for preventive maintenance (Holloway, March, 2000).

FACT BOX

The national median for maintenance and operations costs is $571.75 per student. The median per square foot is $3.72. (AS&U, 2000)

Most school districts currently use some combination of the following equipment maintenance approaches:

- Run to Fail – This approach allows the equipment or part to run until it breaks down or wears out beyond repair. Small, inexpensive, longwearing items are good candidates for this application but it is not appropriate for all equipment.
- Task-Based Maintenance – This work-order based approach addresses lists of broken items or equipment/parts nearing the end of their life cycle. This approach is reactive and focuses on short-term plans.
- Planned/Scheduled Programs – Wear and tear is anticipated in this approach. To obtain maximum efficiency and avoid breakdowns, tasks are performed on a regular basis depending on the manufacturer recommendations. Planned programs include lubricating, checking for proper operation, adjusting and aligning.

With the exception of planned programs, most current approaches are *reactive* in nature causing breakdowns, down time, and in some cases, complete school closure. Financially, these approaches cause considerable peaks in budgets since major renovation or emergency service can double or triple repair costs. Additionally, capital renewal or replacement may become necessary incurring major unexpected costs.

These approaches affect the functionality of a school because code compliance and life/safety issues may be threatened when facilities and systems are not properly maintained. School business officials should look at maintenance as risk management because it is their responsibility to provide staff and students a safe environment in which to teach and learn. The 1995 Government Accounting Office (GAO) survey indicated 46% of 10,000 schools surveyed had inferior electrical wiring that caused a threat for fires. Another study found that 109 pieces of equipment inspected by the State of Maryland in 1996 did not pass inspection. This study came after an unfortunate boiler incident causing a 7-year-old Baltimore student to be scarred by scalding water spewing out a toilet when innocently flushed (Baltimore Morning Sun, September 15, 1996).

Techniques and Equipment Currently Maintained

When school personnel complete facility and infrastructure audits to inventory existing equipment and compare current age with expected lifecycles, they are more apt to fund needed services or plan to address future needs. Table 3 indicates the service life of equipment commonly used in school districts. Service life is a time value that reflects the expected life of a specific component. Service life should not be confused with useful life or depreciation period used for income tax purposes. It is the life expectancy of system components.

Table—3 Equipment Service Life

Equipment Item	Median Years
Air conditioners window unit	10
Water-cooled package	15
Computer room	15
Commercial through-the-wall	15
Heat pumps	
Commercial air-to-air	15
Commercial water-to-air	19
Roof-top air conditioners	
Single-zone	15
Multi-zone	15
Boilers, hot water (steam)	
Steel water-tube	24
Steel fire-tube	25
Cast iron	35
Electric	15
Burners	21
Furnaces	
Gas- or oil- fired	18
unit heaters	
Gas or electric	13
Hot water or steam	20
radiant heaters	
Electric	10
Hot water or steam	
Air terminals	
Diffusers, grilles, and registers	27
Induction and fan-coil units	20
VAV and double-duct boxes	20
Duct work	30
Dampers	20
Fan	
Centrifugal	25
Axial	20
Propeller	15
Ventilating roof-mounted	20
Coils	
DX, water or steam	20
Electric	15
Heat exchangers	
Shell-and-tube	24
Package chillers	
Reciprocating	20
Centrifugal	23
Absorption	23
Cooling towers	
Galvanized metal	20
Wood	20
Ceramic	34
Air-cooled condensers	20
Evaporative condensers	20

Equipment Item	Median Years
Insulation	
Molded	20
Blanket	24
Pumps	
Base-mounted	20
Pipe-mounted	10
Sump and well	10
Condensate	15
Steam turbines	30
Electric motors	18
Motor starters	17
Electric transformers	30
Controls	
Pneumatic	20
Electric	16
Electronic	15
Valve actuators	
Hydraulic	15
Pneumatic	20
Self-contained	10
Reseal parking lots	7
Asphalt pavement	18
Concrete pavement, curb, gutters, walks	22
Chain link fence	30
Elevators	25
Structural systems	55
Roofing	20
Windows/doors	40
Floor covering	
Carpet	12
Vinyl Tile	17
Ceramic Tile	32
Interior paint	12
Exterior paint	8
Ceiling tile	25
Window treatment	20
Lockers academic/athletic	25
Fire alarm	30
Exit lights	20
Emergency lights	
Battery	5
Fixture	12
Clock	35
Lighting	
Ballasts	7
Lens	12
Fixture	20
CATV	
Cable	37
Components	5

Source: Great Lakes/Midwest Region Building Handbook

SOLUTION BOX

If your district does not have the resources to audit current equipment, there are facility companies that offer this service for a reasonable fee..

Table 4—Sample Audit Matrix

Item	Description		Quantity	Age/Year	Expected	Expected	Replacement	Notes/Actions
	Type/Material	Manufacturer		Installed	Service Life	Life Remaining	Cost	
Sidewalks	Concrete		500sq'y	1990	22	12	$6,000	
Air Handler #1	Roof top Multi-Zone		1	1985	15	0	$35,000	

Table 4 is a sample audit matrix that school business officials can use to tailor the columns to their school district's need. A few examples were included for clarification.

Future Technologies and Techniques

To properly address deferred maintenance, today's schools must implement updated maintenance strategies that focus on:

- Identifying the district's goals and understanding the facility's impact on them
- Analyzing and prioritizing all areas in the facility and the systems that serve those areas
- Matching each system and component with the most appropriate service approach

Buildings, building components, and equipment all require various levels of continuous maintenance to achieve or extend their expected useful life. To determine what level of planned maintenance is appropriate for each piece, the facility areas, systems, and equipment first need to be ranked based on criticality.

There are several factors that influence the level of maintenance and capital renewal efforts (APPA, 1997):

- Building size and complexity
- Current age and condition
- Mechanical systems technology
- Electrical systems technology
- Historic or community value
- Criticality of role or function
- Energy prices
- Material prices
- Distance between buildings in inventory

Suggested Equipment for Maintenance & Operations Programs

The following facility systems and equipment should be considered when implementing a maintenance and operations program:

- HVAC Systems
- Electrical/mechanical maintenance
- Energy Systems
- Management services training
- Preventive and predictive maintenance
- Building Automation Systems
- Structural maintenance
- Grounds maintenance
- High voltage maintenance
- Onsite supervision
- Fire/life safety
- Security and building access
- Information and communication networks
- Utilities
- Supply/demand side energy

When completed, this criticality-ranked list will help the school business official identify the right combination of facility strategies, including maintenance and operations. The goal should be to identify realistic budget solutions that address maintenance needs on a timely basis. There are different options available to increase the effectiveness of a school district's maintenance and operation plans, including training, co-sourcing, and complete outsourcing (or all-inclusive agreements).

Proactive training programs for your maintenance and operations staff can have positive effects financially and functionally on your district. Often this department feels under appreciated by not being a direct link to the core competencies of the district's education goals. Additionally, training needs and tools often are forgotten and they operate in an outdated, inefficient mode.

The facility management strategy must include an approach to make existing people better in what they do by training, equipping, and motivating them in a way to increase their productivity, quality, and retention. The resulting efficiency improvements come from more effective and motivated personnel and a reduction of those

who do not add the necessary value.

Computer-based, third party training programs enhance technical skills and effectiveness of staff. These reasonably priced, self-paced programs cover a wide range of equipment and facility topics such as:

- Air conditioning and refrigeration system maintenance
- Buildings and grounds maintenance
- Custodial maintenance
- Electrical systems maintenance
- Materials handling systems
- Mechanical maintenance applications
- Water treatment
- Electronics

Most of these programs were designed to include training analysis, placement tests, various training media, and on-the-job testing as required. Since a well-rounded worker is more productive, some school districts expand training to include professional development courses such as: communication, English as a second language, injury prevention, and refresher classes on reading, writing, and math.

When budgets are a concern and sending staff off-site for training is not possible, a viable option may be to take advantage of existing strategic partnerships to bring training sessions to the facility. These training sessions offer low-cost, high-quality options since the school district is capitalizing on the facility knowledge of these strategic partnerships.

Co-sourcing is the combination of a school district's maintenance staff and a third-party service vendor maintaining the district's equipment. The ranking process discussed above can be used to decide what equipment each party maintains. Complex equipment that require highly technical service or demand a lot of time are the best candidates for co-sourcing. This will allow the school district's maintenance staff to concentrate on proactive maintenance for the remaining equipment and facilities.

One application of co-sourcing is the hiring of a building specialist or project manager who is employed by a third-party vendor but is located at the school district site. The project manager acts as a liaison between the district administration and the building occupants and serves as a consultant to the school district's maintenance staff. Project managers increase maintenance department effectiveness through:

- Prioritizing facility and equipment needs
- Dedicating attention to the critical areas of the facility or facilities
- Accessing years of building experience and knowledge through previous employers
- Providing value-added services such as Computerized Maintenance Management Systems (CMMS) or critical equipment monitoring
- Improving responsiveness to critical facilities through preventive maintenance
- Training of existing staff on new maintenance applications or technology

Another example of co-sourcing is the hiring of an information technology specialist to reprogram the school district's computer system to handle new applications. The school district is only purchasing technical knowledge to complete the task at hand rather than hiring an additional staff person.

Outsourcing or All-inclusive agreements can be used to perform non-core activities traditionally handled by internal staff. Outsourcing involves the prioritization of the school district's focus around core competencies and outside relationships. Traditionally, outsourcing involves the use of on-site personnel.

A survey of more than 500 members of the International Facilities Management Association (IFMA) concluded that 91% of those surveyed were outsourcing/out-tasking at least one support service. Nearly 1,500 public school districts

outsource food service and/or facility management. This number is growing by approximately 10% per year.

Businesses use outsourcing to keep costs in line, remain competitive, and focus on their core strengths. School districts can reap these same rewards. Research from the National School Boards Association indicates most districts that outsource improve efficiency and lower operating costs. Historically, school districts have been extremely sensitive to the outsourcing of internal functions related to physical plant operations and maintenance. Table 5 includes reasons for this reluctance.

All-inclusive outsourcing:

- Allows school districts to focus completely on their core business of education
- Creates a solid career path for technical and maintenance employees
- Provides school districts with ease of mind that highly specialized employees are addressing school facility needs
- Generates operational savings through improved purchasing power, efficient use of technology, proper levels of staffing, cross-utilization of personnel, and energy saving solutions

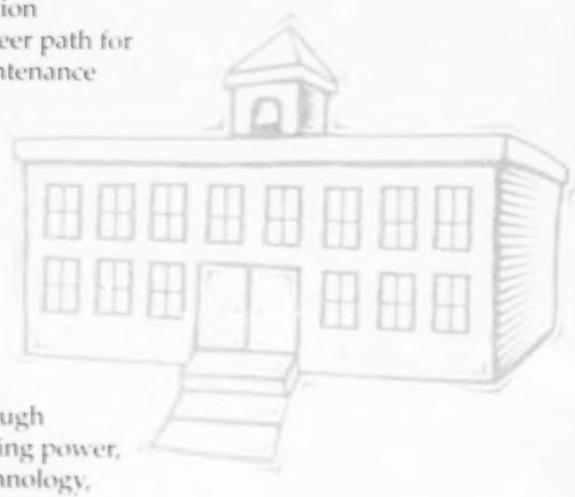


Table 5—Traditional Perceptions and Current Solutions for Outsourcing

Traditional Perception	Current Solution
Many districts feel they will lose control of the methodology by which maintenance tasks are completed.	The outsourcing contract and its desired outcomes should be fully negotiable and outlined by the district administration.
A great percentage of M&O personnel in public education emanate from the district's community and have been employees of the district for years. There is a fear of job loss with outsourcing.	Most of the qualified subcontracted maintenance employees come directly from the district. In fact, through associated training, career paths and skill sets of these employees can be enhanced.
Many school administrators are cautious about employing for-profit businesses for a public district since these businesses are first concerned with making money.	These same for-profit procedures make businesses highly efficient through streamlined processes that can also positively be applied in education.
Popularity of home schooling, private schooling, charter schools, voucher programs, and choice programs has grown through the 1990s. Programs like these cause a potential loss of student headcount and associated funding.	Public school districts can become more competitive in retaining students and recruiting staff by having safe, comfortable facilities to showcase.

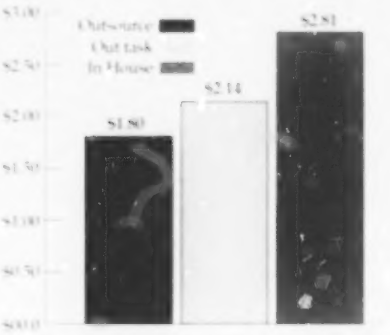
Case Study

Outsourcing provides technical and building expertise in the areas of maintenance and operations that can increase the entire district's standards. When the community of Fort Atkinson, Wisconsin passed a bond to build a much-needed high school, the district found it crucial to protect the investment and the community's trust in the district. The district administrator said, "Our outsourcing partner has seriously raised the bar in terms of high quality maintenance procedures." The outsourced staff on the cleaning shift maintains a 23% higher efficiency than the industry standard motivating the entire district staff to work more efficiently. "We were building the very best school money could buy and we wanted the very best operations and maintenance for the new facility," the administrator added.

According to IFMA (http://www.ifma.org), facility departments are realizing differences in cost per square foot depending on how maintenance and repair costs are handled. Out tasking is the combination of in-house and subcontracting services; what we refer to as co-sourcing in this report. Chart 1 depicts those costs.

If full-time outsourcing seems too big for the school district's need, the district should consider organizing a co-op or consolidating contracts with surrounding districts to leverage purchasing power and tap quality vendor knowledge.

Chart 1—Maintenance & Repair Costs/Sq Ft



Source: International Facilities Management Association. (1997). *IFMA research report #15, benchmarks III.* Houston, TX: Author.

The new cost effective way to solve problems in facilities is to prepare for them in advance. Predictive diagnostics is a set of technologies designed to use current data to formulate a projection of future problems. New testing tools sense signs of problems that could not be detected even a few years ago. In addition to providing continuous quality environments, these services can also reduce the chance of equipment failure by 66% (IEEE, 1985). Specific proactive techniques performed on equipment include:

- **Thermographic scanning** – enables technicians to identify overheating in electrical connections, motors, bearings, couplings, and more. An infrared camera creates precise images of equipment from emitted thermal radiation.
- **Ultrasonic testing** – converts inaudible sounds to those that can be heard through a headset, enabling technicians to listen to electrical arcing caused by faulty electrical connections and defective insulation. Ultrasonic testing is often used to complement infrared testing when panel doors cannot be removed or when components are hard to reach.
- **Vibration analysis** – detects imbalances in rotating components, such as chillers and fans, to help determine their condition, as well as that of associated bearings. Vibration analysis can also help determine the condition of gears, rolling element bearings, shafts, and impellers. It is used in conjunction with other predictive technologies and is a very effective tool for diagnosing machine condition, wear, and alignment.
- **Fluid composition analysis** – identifies potential performance problems, analysis of transformer oil reduces the risk of fire or failure and keeps transformers operating at peak efficiency. The presence of water or acids in lubricating oil indicates leaks that can lead to catastrophic failure; excessive levels of metals signal abnormal wear in bearings or other components.
- **Motor current analysis** – analyzes the line current signal going directly to the motor to determine the condition of the motor rotor bars. Motor current analysis can detect high-resistance joints, cracked or broken rotor bars and end joints before they create a critical failure.

- **Eddy current test** – provides a report on the condition of the condenser and evaporator tubes. This test detects refrigerant or water leaks earlier, circumventing major repairs. In the past, these defects could not be detected until leaks occurred.
- **Flue Gas Combustion Analysis** – measures burner efficiency and detects if the boiler is producing carbon monoxide, sulfur dioxide, or other toxic air problems. Also this analysis evaluates the soot that can decrease heat transfer capabilities and lower efficiency.

Financial Benefites of Preventative Maintenance and Operations

School district superintendents and business officials confront increasing costs, limited resources, operational budget constraints, and rising public expectations. Meeting these challenges, while ensuring educational needs are being met, is a demanding task.

The school budget area that offers the most significant opportunity for controlling and reducing operating and capital costs, while enhancing the learning environment, is facility operations and maintenance. Proactive and efficient facility management positively impacts student and staff health, morale, safety, and motivation. Operations and maintenance strategies enable the school business official to maximize time and resources and to devote attention to the school district's

primary mission – providing students with world class education.

In comparing maintenance costs across all industries, the top half of respondents (or best performers) save *at least* 26% on their maintenance costs compared with the total group. (IFMA, 1997). The respondents' mean cost was $2.09 per square foot versus the median cost of $1.57 per square foot. This cost effectiveness was obtained by:

- Reducing breakdowns and unexpected failures. The cost of scheduled repairs was significantly less than the costs resulting from major breakdowns.
- Having an outsourced staff that stays abreast of all advancements affecting the operations and maintenance industry thereby increasing efficiency. The school district's facilities should be on the cutting edge of technology and comply with all regulations affecting the facilities.
- Consolidating numerous contracts into one single source package minimizing multiple mark-ups.
- Utilizing advanced technology such as Computerized Maintenance Management Systems (CMMS) and Building Automation Systems (BAS) to optimize efficiencies, thereby saving labor dollars. This increased utilization of technology in automation has the benefit of allowing for shifting manpower. The ancillary effect of staff reduction also includes the reduction of benefit, health and retirement costs.
- Utilizing technology-related maintenance extends equipment life and reduces the risk of down time.
- Providing energy-saving solutions and recommendations that reduce utility bills. Technical specialists perform energy cost avoidance work through the course of the contract as needed.
- Controlling material and supply costs by implementing fiscal control policies.
- Realizing significant utility savings that can be driven back into the instructional side of education thereby maximizing resources in the classroom without losing asset protection.

Some of the money to pay for renovations, improvements, and new school buildings could come from energy equity in schools rather than operating funds or traditional funding sources. About $2 billion in energy equity or 25% of the energy consumed in K-12 schools annually is escaping out the school's front door, floating out the windows, or rising from the roof. Energy equity can be captured by improving or replacing the school's energy-consuming and building envelope systems providing a healthier, more comfortable, high-quality learning environment (Schoff, 2000).

The departments that are typically outsourced are those that are not a direct link to the districts' core competency of education. The use of subcontractors as an answer to reduced operating budgets became popular in the early 1990s when districts were faced with substantial budget shortfalls and efficiency, not comfort, became the focus of the administration. Functions such as food service, material management, transportation, and grounds keeping are experiencing increasing levels of privatization.

Integrating New Maintenance and Operations Into Existing Plans

When implementing new maintenance and operations efforts into the school district's existing plan, benchmarking of current costs per square foot is important. Not only does benchmarking allow the school business official to compare school statistics against regional and national data to set expectations, it also allows the school business official to generate internal comparisons to ensure expected savings are met as dictated by the outsource vendor.

It is helpful to introduce technologically advanced systems into a school district's maintenance and operations program. New computer-software programs such as CMMS are designed to assist in the planning, management, and administrative procedures required for effective maintenance procedures. The fruit of CMMS is the history it produces. Equipment information, combined with periodic or unscheduled tasks, is designed to trigger work orders. Work orders generate complete work plans and resource requirements. The work order must be closed and the information becomes part of the equipment's permanent service history. Analysis and reports provide critical feedback for equipment monitoring and improvements to the maintenance process.

With CMMS, a well-managed maintenance program will result in greater building-occupant satisfaction and the ability to:

- Reduce unscheduled downtime and improve equipment performance
- Better utilize maintenance time, resources, and budget monies
- Lower inventory costs with more timely parts available
- Improve access to diagnostic and repair data, history, and other useful information
- Extend life of equipment and redirect costs associated with replacement

Case Study – Paperless Construction

Kent School District, Kent, Washington, implemented a paperless facility maintenance department as part of their newly constructed facility. During construction, contractors and bidders received a CD that contained all the information needed to bid on the district's newest elementary school, including program software, contract documents, and drawings. The CD allowed the district to save time and money, reduce bidding errors and construction problems, and improve communication.

The project was pressed on CD because some contractors do not have the resources to download big files over the Internet. Training in electronic commerce was provided at no charge to any contractor who needed it. Contractors submitted their bids in the traditional paper format.

The CD replaced mounds of paperwork that potential bidders normally receive on a project. Additionally, there are substantial cost savings in using a CD in place of paper; $600 versus $25,000. The federal government, a pioneer in electronic bidding, has determined the resulting cost savings are 75% to 85%.

The second half of the plan includes using a web site for online electronic project management during construction. All of the construction management tools and techniques are housed, updated, and managed on the site and most communications between the design team, school district, and contractor is by email. The district does not anticipate any written communication on the project. The website enables the district to track costs and change orders better. Each party on the project will have differing levels of access to the website, allowing them to make adjustments to specific parts of the plans that affect them.

Work orders are now accessed through the web and equipment detail is being gathered for long-term monitoring.

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Maintenance and Operations in New Construction

When developing a new construction plan, school business officials should take a long term, life cycle view. Construction costs are only a small portion of a building's costs over its lifetime; operation and maintenance accounts for far more. Quite often when bonds are passed for a new school facility, the majority of the dollars is earmarked for what people see; the building itself, technology, sports complexes, and auditoriums. Few dollars, if any, are passed for maintenance and operations of the facility and its systems.

Table 6—Percentage of Original Facility Costs Over 40 Years of Facility Life

Construction	11%
Operations	50%
Alterations	25%
Financing	14%

Source: American Society of Heating, Refrigerating, and Air Conditioning. (1999). *HVAC Applications*. Atlanta, GA: Author.

During the referendum process, the school business official should separate the construction and maintenance of a new facility into two bonds. Doing so allows the school business official to properly address the building construction *and* the long-term care (e.g. 10 years) of the facility. Most communities want to build the best school money can buy. School district officials also want to protect the investment of the new facility, which would increase the community's trust in the district.

Some districts are utilizing commissioning as a way to ensure they get what they paid for during new construction. Basically, commissioning is the physical demonstration that "critical systems" work 100% as designed and specified. The purpose of the commissioning process is to hold everyone, including the design team, contractor, subcontractor, owner, and district's maintenance and operations staff, accountable for their respective responsibilities for all critical systems associated with the building. Critical systems can be defined as the equipment, special systems, and mechanical, electrical, signal (phone, intercom, alarms) and civil (topographical, verification/irrigation) systems that are included in the project. There are several reasons why commissioning is a critical process in any major construction project. It results in:

- Creation of an environmentally desirable building for occupancy by students, staff, parents and the public
- Accountability to taxpayers that the quality of the building has been verified
- Certification and documentation that all systems were completed and perform as designed. This also creates a performance baseline for future decisions
- Proof of performance for all parties to the construction process

Safe, clean, well-maintained schools enhance student achievement and teacher satisfaction, and create community good will. Curb appeal gives the community confidence the district is a good steward of their tax dollars and future support will follow.

Public schools are realizing that solid community relationships are critical to the schools' growth and health. Although the physical plant is a seemingly minor factor, its appearance can significantly affect image. School systems should visually reflect the quality and care inside each classroom. A well-tended campus creates an image for someone who may never have had a child in your classroom or have spoken to a school employee (Carroll & Carroll, 1994).

Recommendations for Change

A properly implemented maintenance and operations plan *will* help school districts avoid costs, protect assets, and increase staff productivity. To begin integrating these ideas into the district's maintenance and operations efforts, school business officials should:

- Share these philosophies with staff so the entire department is working toward the same goal
- Analyze existing maintenance efforts and rank facility/equipment needs
- Investigate maintenance options such as training, co-sourcing, and outsourcing
- Integrate those options that best fit into the district's needs, capabilities, and goals
- Continue to assess maintenance status and needs and make appropriate changes

Maintenance and Operations Providers

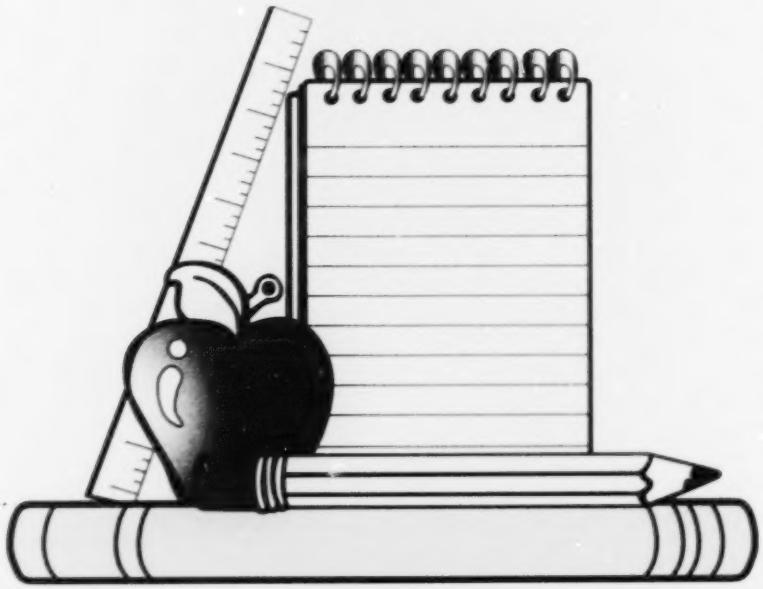
There are a growing number of vendors in the facilities business that offer a wide arrangement of maintenance and operations services. To begin learning about these organizations, school business officials should visit the Exhibit Hall during ASBO International's Annual Meeting and Exhibits held in the fall of each year and subscribe to industry publications that cover this topic, including *School Business Affairs*, *Facilities Manager*, and *American School & University*.

Implement Maintenance Programs with Caution

The school business official should begin the implementation of a new maintenance program with the most critical components and expand it later to include additional items. During the initial phases of the program, the demand for resources (labor and material) will be high since much time will still be spent on existing breakdowns. As staff becomes more efficient through planned maintenance programs, the allocation of time will improve. Finally, school business officials should remember to create a maintenance program specific to each piece of equipment. Not all systems need the same level of maintenance; a combination of preventive, predictive, proactive, and reactive approaches should be used.

Conclusion

School districts will always face the challenge of balancing budgets and doing more with less. However, the status quo of "fix it when it breaks" is no longer acceptable or prudent in today's schools where students, parents, and staff expect more of school facilities. School business officials must realize the positive impact an improved maintenance and operations plan has on the district's ability to provide an exceptional educational environment for students and teachers. ■



References

American Association of School Administrators. (1992). *NASBE Building our Future: making school facilities ready for the 21st Century.* Washington, DC: Author.

Association of Higher Education Facilities Officers (APPA). (1997). *Facilities management: a manual for plant administration. Part II: Maintenance and operations of buildings and grounds* (3rd ed.). Alexandria, VA: Author.

Carroll, S. R. & Carroll, D. (1994). *How smart schools get and keep community support.* Washington, DC: National Educational Service.

Corcoran, T. B., Walker, L. J., & White, J. L. (1988). *Working in urban schools.* Washington, DC: Institute for Educational Leadership.

Department of Education. (1998). *Impact of inadequate school facilities on student learning* [On-line]. Available: http://www.ed.gov/inits/construction/impact2.html

General Accounting Office. (1995). *School facilities: the condition of America's schools.* (1995). Report to Congressional Requesters. Washington, DC: Author.

General Accounting Office. (1996). *School facilities: profile of school conditions by state.* (1996). Report to Congressional Requesters. Washington, DC: Author.

Holloway, J. H. (March, 2000). Research link: healthy buildings, successful students. *Education Leadership*, 57 (6). Available: http://www.ascd.org/readingroom/edlead/0003/holloway.html.

Honeyman, D. S. (Fall, 1990). School facilities and state mechanisms that support school construction: a report from the 50 States. *Journal of Education Finance*, 247-272.

Institute of Electrical and Electronics Engineers (IEEE). (1985). *Recommended practice for electromagnetic site survey.* Piscataway, NJ: Author.

International Facilities Management Association (IFMA). (1997). *IFMA research report #18, benchmarks III.* Houston, TX: Author.

Maintenance & operations cost study. (1999). *American School & University*, 72 (8), 22-30.

Moberly, D. L. (February, 1999). Commissioning new buildings. *American School & University*, 71 (6), 48-49.

Schoff L. (2000). Energy Equity Lost and Found: Rebuilding America's K-12 Schools [On-line]. Available: http://www.appa.org/k12/

State faults schools on boiler safety. (1996, March 15). *Baltimore Morning Sun*, pp 1A.

Wireman, T. (1994). *Computerized maintenance management services* (2nd ed.). New York, NY: Industrial Press.

Bibliography

Association of School Business Officials International. (1999). *Financing school facilities.* A supplement to *School Business Affairs.* Reston, VA: Author.

Association of School Business Officials International. (1995). *Maintenance & operations and the school business administrator.* A compilation of articles from *School Business Affairs.* Reston, VA: Author.

Biehle, James T. (April, 2000). Invest now or pay later. *American School & University, 72 (8),* 46-47.

Building systems performance (January, 2000). Supplement to *HPAC Engineering*, 10.

Minnick, B. (February 12, 1999). A Lesson in Electronic Bidding. *Seattle Daily Journal of Commerce* [On-line]. Available: http://www.djc.com/.

Facilities Project Team

ASBO International and Johnson Controls, Inc., joined forces to examine crucial issues that impact school facility infrastructure. *Maintenance & Operation Solutions: Meeting The Challenge of Improving School Facilities* is the second of three publications to assist school business officials with the challenges of improving school facilities. The first publication, *Financing School Facilities*, can be purchased on ASBO's website at http://www.asbointl.org. To research and gather this type of information, a project team was assembled from a cross-section of ASBO International's volunteer committees. Members of this project team include the following:

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About ASBO International

The Association of School Business Officials (ASBO) International is a professional association representing over 6,000 members. ASBO International provides programs and services to promote the highest standards of school business management practices, professional growth, and the effective use of educational resources. You can access ASBO International 24 hours a day by visiting our website at http://www.asbointl.org.

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- Customer training and professional development programs
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- Maintenance and operations services for buildings, systems, and grounds
- Financial services
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